

The analytical system for methanol consists of a gas chromatograph (GC) equipped with a flame ionization detector. The analysis for formaldehyde is performed using high pressure liquid chromatography (HPLC) of 2,4-dinitrophenylhydrazine (DNPH) derivatives using ultraviolet (UV) detection. The exhaust gas analytical system shall conform to the following requirements:

(1) The CL requires that the nitrogen dioxide present in the sample be converted to nitric oxide before analysis. Other types of analyzers may be used if shown to yield equivalent results and if approved in advance by the Administrator.

(2) The carbon monoxide (CO) NDIR analyzer may require a sample conditioning column containing CaSO_4 , or indicating silica gel to remove water vapor and containing ascarite to remove carbon dioxide from the CO analysis stream.

(i) If CO instruments which are essentially free of CO_2 and water vapor interference are used, the use of the conditioning column may be deleted, see §§ 86.122 and 86.144.

(ii) A CO instrument will be considered to be essentially free of CO_2 and water vapor interference if its response to a mixture of 3 percent CO_2 in N_2 which has been bubbled through water at room temperature produces an equivalent CO response, as measured on the most sensitive CO range, which is less than 1 percent of full scale CO concentration on ranges above 300 ppm full scale or less than 3 ppm on ranges below 300 ppm full scale, see § 86.122.

(3) For petroleum-fueled diesel vehicles (and if selected, for methanol-fueled diesel vehicles) a continuous hydrocarbon sample shall be measured using a heated analyzer train as shown in Figure B90-5 (or B90-6). The train shall include a heated probe, a heated continuous sampling line, a heated particulate filter and a heated hydrocarbon instrument (HFID) complete with heated pump, filter and flow control system.

(i) The response time of this instrument shall be less than 1.5 seconds for 90 percent of full scale response.

(ii) The continuous HC sample system may use an "overflow" zero and span system; see § 86.140-82(b)(4). In this

type of system (figures B82-3A and B82-4A), zero or span gas is introduced into the heated sample line at a flow rate that exceeds the sample flow rate to the HFID. The excess gas overflows the sample probe into the dilution tunnel. This method assures that the reference gas enters HFID in the same concentration as the injected reference gas and at the same rate as the sample exhaust gas. In addition to zero and span checks, it may also be used to calibrate the HC analyzer per § 86.121-82(b). The overflow gas flow rate into the sample line shall be greater than 125 percent of the HFID flow rate with the CVS blower operating. A lower flow rate may be used if it has been experimentally shown to produce equivalent results and current documentation is maintained. The overflow gases shall enter the heated sample line as close as practicable to the outside surface of the dilution tunnel.

(iii) No other analyzers may draw a sample from the continuous HC sample probe, line or system, unless a common sample pump is used of all analyzers and the single sample line system design reflects good engineering practice.

(iv) Sample transport time from sampling point to inlet of instrument shall be less than 4 seconds.

(v) For petroleum-fueled diesel vehicles, the sample line and filter shall be heated to maintain a sample gas temperature of 375 ± 10 °F (191 ± 6 °C) before the filter and before the HFID.

(vi) For methanol-fueled diesel vehicles, the sample line and filter shall be heated to maintain a sample gas temperature of 235 ± 15 °F (113 ± 8 °C) before the filter and before the HFID.

(c) *Other analyzers and equipment.* Other types of analyzers and equipment may be used if shown to yield equivalent results and if approved in advance by the Administrator.

[54 FR 14512, Apr. 11, 1989]

§ 86.111-94 Exhaust gas analytical system.

Section 86.111-94 includes text that specifies requirements that differ from § 86.111-90. Where a paragraph in § 86.111-90 is identical and applicable to § 86.111-94, this may be indicated by specifying the corresponding paragraph and the statement "[Reserved]. For

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guidance see § 86.111-90.” Where a corresponding paragraph of § 86.111-90 is not applicable, this is indicated by the statement “[Reserved].”

(a) *Schematic drawings.* Figure B94-7 is a schematic drawing of the exhaust gas analytical system for samples from bag sampling systems for analysis of total hydrocarbon (THC) (hydrocarbon plus methanol in the case of methanol-fueled vehicles), methane (CH₄) (for vehicles subject to the NMHC and NMHCE standards), carbon monoxide (CO), carbon dioxide (CO₂), and oxides

of nitrogen (NO_x). The schematic diagram of the continuous THC analysis train (and for THC plus methanol for methanol-fueled diesel-cycle vehicles) is shown as part of Figure B94-5 (or Figure B94-6). Since various configurations can produce accurate results, exact conformance with either drawing is not required. Additional components such as instruments, valves, solenoids, pumps, and switches may be used to provide additional information and coordinate the functions of the component systems.

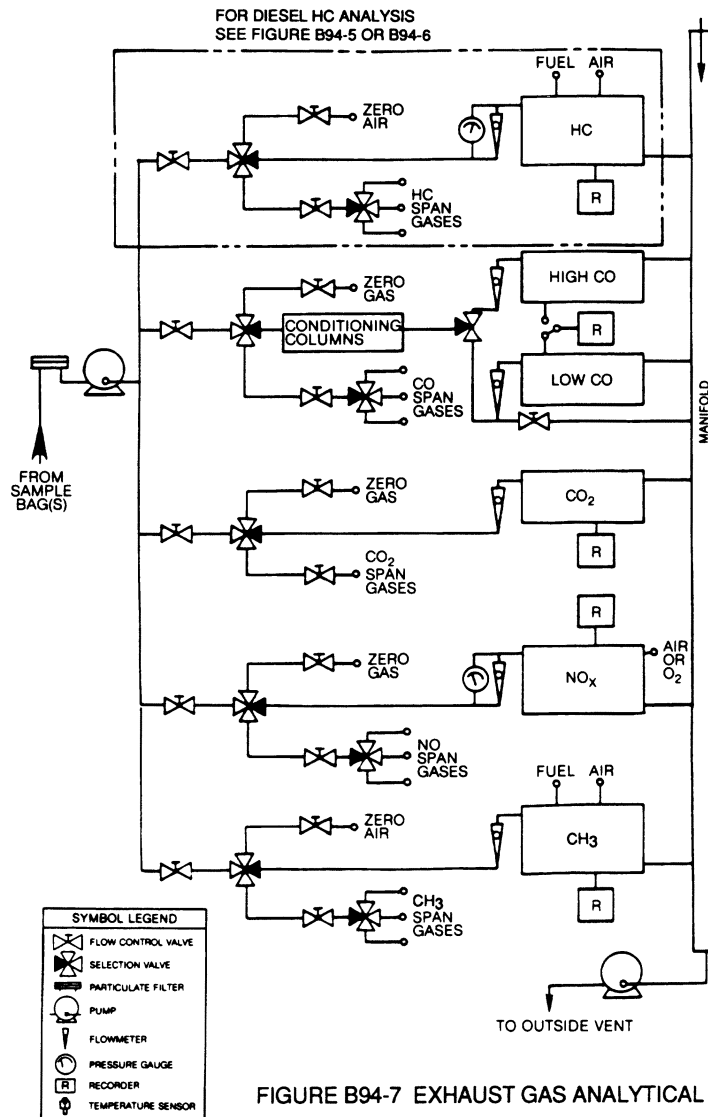


FIGURE B94-7 EXHAUST GAS ANALYTICAL SYSTEM

(b) *Major component description.* The exhaust gas analytical system, Figure B94-7, consists of a flame ionization detector (FID) (heated, $235 \pm 15^\circ\text{F}$ ($113 \pm 8^\circ\text{C}$)) for methanol-fueled vehicles) for the determination of THC, a methane analyzer (consisting of a gas chromatograph combined with a FID) for the determination of CH_4 (for vehicles

subject to the NMHC and NMHCE standards, where applicable), non-dispersive infrared analyzers (NDIR) for the determination of CO and CO_2 and a chemiluminescence analyzer (CL) for the determination of NO_x . A heated flame ionization detector (HFID) is used for the continuous determination of THC from petroleum-fueled diesel-

cycle vehicles (may also be used with methanol-fueled diesel-cycle vehicles), Figure B94-5 (or B94-6). The analytical system for methanol consists of a gas chromatograph (GC) equipped with a flame ionization detector. The analysis for formaldehyde is performed using high pressure liquid chromatography (HPLC) of 2,4-dinitrophenylhydrazine (DNPH) derivatives using ultraviolet (UV) detection. The exhaust gas analytical system shall conform to the following requirements:

(1) The CL requires that the nitrogen dioxide present in the sample be converted to nitric oxide before analysis. Other types of analyzers may be used if shown to yield equivalent results and if approved in advance by the Administrator.

(2) The carbon monoxide (CO) NDIR analyzer may require a sample conditioning column containing CaSO_4 , or indicating silica gel to remove water vapor, and containing ascarite to remove carbon dioxide from the CO analysis stream.

(i) If CO instruments which are essentially free of CO_2 and water vapor interference are used, the use of the conditioning column may be deleted, see §§ 86.122 and 86.144.

(ii) A CO instrument will be considered to be essentially free of CO_2 and water vapor interference if its response to a mixture of 3 percent CO_2 in N_2 which has been bubbled through water at room temperature produces an equivalent CO response, as measured on the most sensitive CO range, which is less than 1 percent of full scale CO concentration on ranges above 300 ppm full scale or less than 3 ppm on ranges below 300 ppm full scale, see § 86.122.

(3) For petroleum-fueled diesel vehicles (and if selected, for methanol-fueled, natural gas-fueled and liquefied petroleum gas-fueled diesel vehicles) a continuous hydrocarbon sample shall be measured using a heated analyzer train as shown in Figure B90-5 (or B90-6). The train shall include a heated probe, a heated continuous sampling line, a heated particulate filter and a heated hydrocarbon instrument (HFID) complete with heated pump, filter and flow control system.

(i) The response time of this instrument shall be less than 1.5 seconds for 90 percent of full scale response.

(ii) The continuous THC sample system may use an "overflow" zero and span system; see § 86.140-82(b)(4). In this type of system (figures B82-3A and B82-4A), zero or span gas is introduced into the heated sample line at a flow rate that exceeds the sample flow rate to the HFID. The excess gas overflows the sample probe into the dilution tunnel. This method assures that the reference gas enters HFID in the same concentration as the injected reference gas and at the same rate as the sample exhaust gas. In addition to zero and span checks, it may also be used to calibrate the THC analyzer per § 86.121-82(b). The overflow gas flow rate into the sample line shall be greater than 125 percent of the HFID flow rate with the CVS blower operating. A lower flow rate may be used if it has been experimentally shown to produce equivalent results and current documentation is maintained. The overflow gases shall enter the heated sample line as close as practicable to the outside surface of the dilution tunnel.

(iii) No other analyzers may draw a sample from the continuous THC sample probe, line, or system, unless a common sample pump is used of all analyzers and the single sample line system design reflects good engineering practice.

(iv) Sample transport time from sampling point to inlet of instrument shall be less than 4 seconds.

(v) For petroleum-fueled, natural gas-fueled and liquefied petroleum gas-fueled diesel vehicles, the sample line and filter shall be heated to maintain a sample gas temperature of $375^\circ \pm 10^\circ \text{F}$ ($191^\circ \pm 6^\circ \text{C}$) before the filter and before the HFID.

(vi) For methanol-fueled diesel-cycle vehicles, the sample line and filter shall be heated to maintain a sample gas temperature of $235^\circ \pm 15^\circ \text{F}$ ($113^\circ \pm 8^\circ \text{C}$) before the filter and before the HFID.

(vii) Using a methane analyzer consisting of a gas chromatograph combined with a FID, the measurement of methane shall be done in accordance

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with the Society of Automotive Engineers, Inc. (SAE) Recommended Practice J1151, "Methane Measurement Using Gas Chromatography," December 1991, 1994 SAE Handbook—SAE International Cooperative Engineering Program, Volume 1: Materials, Fuels, Emissions, and Noise; Section 13 and page 170 (13.170), which is incorporated by reference.

(A) This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51.

(B) Copies may be inspected at U.S. EPA, OAR, 401 M St., SW., Washington, DC 20460, or at the National Archives and Records Administration (NARA). For information on the availability of this material at NARA, call 202-741-6030, or go to: http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html. Copies of this material may be obtained from Society of Automotive Engineers International, 400 Commonwealth Drive, Warrendale, PA 15096-001.

(c) *Other analyzers and equipment.* Other types of analyzers and equipment may be used if shown to yield equivalent or superior results and if approved in advance by the Administrator.

[56 FR 25771, June 5, 1991, as amended at 58 FR 33209, June 16, 1993; 59 FR 48505, Sept. 21, 1994; 59 FR 50073, Sept. 30, 1994]

EFFECTIVE DATE NOTE: At 75 FR 25677, May 7, 2010, § 86.111-94 was amended by revising paragraph (b) introductory text, effective July 6, 2010. For the convenience of the user, the revised text is set forth as follows:

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(b) *Major component description.* The exhaust gas analytical system, Figure B94-7, consists of a flame ionization detector (FID) (heated, 235 °±15 °F (113 °±8 °C) for methanol-fueled vehicles) for the determination of THC, a methane analyzer (consisting of a gas chromatograph combined with a FID) for the determination of CH₄, non-dispersive infrared analyzers (NDIR) for the determination of CO and CO₂, a chemiluminescence analyzer (CL) for the determination of NO_x, and an analyzer meeting the requirements specified in 40 CFR 1065.275 for the determination of N₂O (required for 2015 and later model year vehicles). A heated flame ionization detector

(HFID) is used for the continuous determination of THC from petroleum-fueled diesel-cycle vehicles (may also be used with methanol-fueled diesel-cycle vehicles), Figure B94-5 (or B94-6). The analytical system for methanol consists of a gas chromatograph (GC) equipped with a flame ionization detector. The analysis for formaldehyde is performed using high-pressure liquid chromatography (HPLC) of 2,4-dinitrophenylhydrazine (DNPH) derivatives using ultraviolet (UV) detection. The exhaust gas analytical system shall conform to the following requirements:

* * * * *

§ 86.112-91 Weighing chamber (or room) and microgram balance specifications.

(a) *Ambient conditions*—(1) *Temperature.* The temperature of the chamber in which the particulate filters are conditioned and weighed shall be maintained to within ±10 °F (6 °C) of a set point between 68 °F (20 °C) and 86 °F (30 °C) during all filter conditioning and filter weighing. A continuous recording of the temperature is required.

(2) *Humidity.* The relative humidity of the chamber in which the particulate filters are conditioned and weighed shall be maintained to within ±10 percent of a set point between 30 and 70 percent during all filter conditioning and filter weighing. A continuous recording of the temperature is required.

(3) The environment shall be free from any ambient contaminants (such as dust) that would settle on the particulate filters during their stabilization.

(4) It is required that two unused reference filters remain in the weighing room at all times in covered (to reduce dust contamination) but unsealed (to permit humidity exchange) petri dishes. These reference filters shall be placed in the same general area as the sample filters. These reference filters shall be weighed within 4 hours of, but preferably just prior to, the pre- and post-test sample filter weighings.

(5) If the weight of either of the reference filters changes between pre- and post-test sample filter weighings by more than ±2.0 percent of the test average primary filter loading (recommended minimum of 0.5 milligrams) or ±0.010 milligrams, whichever is